



PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Masayuki KIKUSHIMA

Application No.: 09/806,934

Filed: April 6, 2000

For: PIEZOELECTRIC DEVICE AND METHOD FOR MANUFACTURING THE SAME

Group Art Unit: 2834

Examiner: M. Budd

Docket No.: 108574

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AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D.C. 20231

Sir:

In reply to the Office Action mailed March 7, 2002, please amend the above-identified application as follows:

IN THE CLAIMS:

Please replace claim 10 as follows:

10. (Twice Amended) The piezoelectric device according to claim 1, at least one side wall of the base facing the side of the semiconductor integrated circuit protruding into the opening to form a protrusion.

REMARKS

Claims 1-32 are pending herein, with claims 31 and 32 being withdrawn from consideration by way of a Restriction Requirement. By this Amendment, claim 10 is amended to re-phrase the claim without limiting the claim.

The attached Appendix includes a marked-up copy of the rewritten claim (37 C.F.R. §1.121(c)(1)(ii)).

In view of the foregoing amendment and the following remarks, reconsideration of the application is respectfully requested.

Applicant appreciates the courtesies shown to Applicant's representative by Examiner Budd in the May 29, 2002 interview. Applicant's separate record of the substance of the interview is incorporated into the following remarks.

I. Request for Approval of Drawing Corrections

Submitted with the Preliminary Amendment filed with the application on April 6, 2001 was a Request for Approval of Drawing Corrections. The Examiner is respectfully requested to indicate approval of the proposed drawing corrections in the next communication.

II. Rejection Under 35 U.S.C. §102(a)

Claims 1, 8, 9, 14, 20-24 and 27-30 were rejected under 35 U.S.C. §102(a) as allegedly being anticipated by JP -07-297666 (JP 666). This rejection is respectfully traversed.

JP 666 describes a surface mounted type piezoelectric oscillator having improved impact resistance. As shown in Figures 1-3 of JP 666, the integrated circuit chip 2 in the oscillator is not mounted in an opening formed in a center of a base as required in each of independent claims 1, 14 and 22. It is explained in JP 666 that the location of the integrated circuit chip 2 toward a side of the substrate is required in order to avoid stress distortion that may damage the electronic parts when a piezoelectric plate bends due to an impact from the exterior. The side location of the integrated circuit is described to be able to better handle the bending stress without damage to either the integrated circuit or piezoelectric plate.

For the foregoing reasons, JP 666 clearly fails to anticipate any of the rejected claims.

Moreover, one of ordinary skill in the art would not have been led to the present invention from the teachings of JP 666 in view of JP 666 teaching that the integrated circuit chip 2 should be located at a side edge of the oscillator and not in a center portion thereof as in conventional oscillators such as shown in Figure 4 of JP 666. In fact, JP 666 would have led one of ordinary skill in the art away from the presently claimed invention.

For all the foregoing reasons, Applicant respectfully submits that JP 666 neither anticipates nor would have rendered obvious the invention as recited in claims 1, 8, 9, 14, 20-24 and 27-30. Reconsideration and withdrawal of this rejection are respectfully requested.

III. Rejections Under 35 U.S.C. §103(a)

A. Kondo or Knecht in View of JP 732, JP 540 or JP 606

Claims 1-9 and 14-20 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 5,949,294 (Kondo) or U.S. Patent Nos. 5,405,476 (Knecht) in view of JP 04-18732 (JP 732), JP 08-264540 (JP 540) or JP 08-222606 (JP 606). This rejection is respectfully traversed.

Kondo describes an oscillator formed from first and second containers, the first container including an integrated circuit active element 2 mounted therein and electrically connected to electrodes via wire bonding 12. A second, separate container 3 has an oscillating element 6 incorporated therein, and the second container 3 is attached onto an opening of the first container 1 so that electrodes of the respective containers are connected. By using separate containers, it is described that a damaged part may be easily removed and replaced without having to dispose of the entire unit. See the Abstract.

Knecht describes a particular method of mounting a piezoelectric element to a substrate using compliant conductive materials. As shown in Figure 2 of Knecht, the oscillator 100 includes an integrated circuit chip 104 mounted upon a substrate 106 and

connected to input-output pads via wire bonding. A piezoelectric element 102 is mounted upon ledges or sides 126 and 128 above the integrated circuit chip.

In the Office Action, it was acknowledged that neither Kondo nor Knecht taught or suggested connecting a semiconductor integrated circuit to an input/output electrode pattern through a plurality of bumps. The Patent Office asserted that the use of flip-chip bump connections for coupling an integrated circuit chip to a base was well known as allegedly demonstrated by JP 732, JP 540 and JP 606. Applicant respectfully does not agree that one of ordinary skill in the art would have been led to the presently claimed invention from the teachings of these references.

While flip-chip mounting may in general be known, Applicant respectfully submits that such general knowledge alone would not have enabled one of ordinary skill in the art to have derived the presently claimed invention, i.e., to have replaced wire bonding in piezoelectric devices of the type claimed with such flip-chip mounting. For example, as described on pages 10-12 of the present specification, there are several steps that must be taken and carefully controlled in bonding an integrated circuit chip using a plurality of bumps via the flip-chip bonding process. For example, the temperature of the bonding, the height and shape of the plurality of the bumps, the application of the ultrasonic waves for bonding, the application of stress upon each of the different bumps during bonding, etc. all may be required to be carefully controlled in order to successfully align and bond the integrated circuit to the electrode pattern. This is further complicated in the context of the piezoelectric device of the invention in which the integrated circuit chip is designed to fit very closely within a confined opening of a base portion of the device so that the device is able to better withstand mechanical impacts. Such close fitting of an integrated circuit within an opening is not a factor in either Kondo or Knecht (illustrating large spacings for the wire bonding) and is

also not a factor in any of JP 732 , JP 540 or JP 606 (all merely illustrating flip-chip bonding procedures not confined by bonding within an opening as in the present invention).

Still further, the switch from wire bonding to flip-chip bonding in a piezoelectric device of the type claimed does not merely require alteration of the bonding procedure as the Patent Office alleges. Instead, other aspects of the device have to be redesigned as well, for example including the structure of the input/output electrodes through the substrate of a base portion of the device. None of the references cited by the Patent Office teach or suggest how one of ordinary skill in the art would have to deal such other design considerations in changing from wire bonding as in Kondo or Knecht to flip-chip bonding.

For the foregoing reasons, Applicant respectfully submits that one of ordinary skill in the art would not have been led to the presently claimed invention from the art cited by the Patent Office, such art not teaching or suggesting how one of ordinary skill in the art could modify the devices of Kondo and Knecht in a manner necessary to have derived the presently claimed invention.

Concerning JP 732, this reference teaches arranging bump electrodes in a concentric circle so that stress imposed on the device when tightening screws is imposed evenly on the bumps. JP 732 is thus concerned with evenly distributing stress for devices to be attached with screws, a concern absent from Kondo, Knecht and the presently claimed invention. One of ordinary skill in the art would not have turned to the teachings of JP 732 as a concern for the distribution of stress and screw tightening is of no relevance to Kondo, Knecht or the presently claimed invention.

Concerning JP 540, this reference merely describes a novel method for preparing a bump electrode having a two bump structure. JP 540 does not teach or suggest in what types of devices such bump structure is useful or how it might be applied to replace wire bonding in the specific types of piezoelectric devices presently claimed.

JP 606 describes including additional bumps upon the surface of a substrate in order to reduce the number of faulty connections to a circuit pattern. Like JP 540 discussed above, JP 606 does not teach or suggest in what types of devices such technology might be useful, and does not teach or suggest how it could be used to replace wire bonding in the specific types of piezoelectric devices presently claimed.

For all the foregoing reasons, reconsideration and withdrawal of this rejection are respectfully requested.

1. Claims 2 and 15

Claims 2 and 15 further recite that the plurality of bumps are formed at regular intervals on a center portion of an active element surface. None of the art cited by the Patent Office teaches such design. JP 732 is not relevant and would not have been combined with the teachings of the other references relied upon by the Patent Office as discussed extensively above. Further, arranging the bumps in a concentric circle as in JP 732 does not teach or suggest forming a plurality of bumps at regular intervals on a center portion of an active element surface. The plurality of bumps in JP 606 also are not formed on a center portion of an active element surface. Claims 2 and 15 are further distinguished over the art cited in the Office Action for this additional reason.

2. Claim 3

Claim 3 recites that the plurality of bumps are concentrically formed about a center of an active element surface. JP 732 is not relevant to the claimed invention, and would not have been turned to by one of ordinary skill in the art. None of the other cited art teach or suggest this additional feature recited in claim 3.

3. Claims 6 and 18

Claims 6 and 18 recite that the device includes a layered part comprising at least two layers surrounding the semiconductor integrated circuit, the opening of the first layer being larger than the opening of the second layer. Neither Kondo nor Knecht teach or suggest a device including such a layered part. Knecht teaches the mounting of the integrated circuit upon a substrate with no layered parts at all. Kondo similarly describes that the integrated circuit is mounted upon a substrate without layered parts. Applicant respectfully submits that claims 6 and 18 define over the art relied upon in the Office Action for this additional reason.

4. Claims 23, 24 and 29

Claims 23, 24 and 29 further recite particular properties of the structure of the device related to an application direction of the ultrasonic waves. None of the art cited by the Patent Office teaches or suggests any of these properties. These claims further distinguish over the teachings of the cited art in the Office Action for this additional reason.

5. Claims 7, 19, 25 and 26

Claims 7, 19, 25 and 26 recite specific parameters for the bump structure of the plurality of bumps. While JP 540 describes a bump structure comprising two layers, JP 540 does not teach or suggest the parameters recited in these dependent claims. These dependent claims thus further distinguish over the art cited in the Office Action for this additional reason.

B. Kondo or Knecht in View of JP 540 or JP 606 and Further in View of Inoi

Claims 10-13 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Kondo or Knecht in view of JP 540 or JP 606, and further in view of U.S. Patent No. 6,057,633 (Inoi). This rejection is respectfully traversed.

Dependent claim 10 recites that at least one side wall of the base facing the side of the semiconductor integrated circuit protrudes into the opening in the base to form a protrusion. As acknowledged by the Patent Office, none of Kondo, Knecht, JP 540 or JP 606 teach or suggest this feature. The Patent Office turned to the teachings of Inoi as allegedly suggesting this feature. Applicant respectfully disagrees.

Inoi describes a piezoelectric transformer unit that includes two casings that snap together to house therein the piezoelectric transforming element. As shown in Figure 11 and described at column 8 of Inoi, the piezoelectric transforming element may include elastic projections thereon so that the unit generates an extremely small amount of noise during operation since the projections prevent the element from directly touching the casing. See column 9, lines 5-9.

Inoi thus describes elastic protrusions attached to the surface of the piezoelectric transformer element. Such does not teach or suggest a side wall of a base facing a semiconductor integrated circuit protruding into an opening in the base to form a protrusion. The protrusion in claim 10 is formed in a side wall of the base, and is not a protrusion from a surface of the integrated circuit as in Inoi. Inoi thus does not teach or suggest the additional features of claims 10-13 of the present invention.

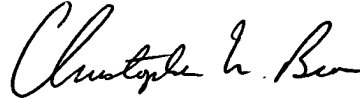
For at least the foregoing reasons, Applicant respectfully submits that none of Kondo, Knecht, JP 540, JP 606 or Inoi would have led one of ordinary skill in the art to the invention of claims 10-13. Reconsideration and withdrawal of this rejection are respectfully requested.

IV. Conclusion

In view of the foregoing amendment and remarks, Applicant respectfully submits that claims 1-32 are in condition for allowance. Should the Examiner believe that anything

further is necessary in order to place the application in even better condition, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,



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JAO:CWB/rxg

Attachment:
Appendix

Date: May 30, 2002

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**DEPOSIT ACCOUNT USE
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